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The Electric Field as a form of Acceleration

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Abstract

Gravity is already recognized as form of Acceleration, but the nowadays Science of Physics does not recognize (yet) the Electric Field also as a form of Acceleration.

Based on ***structural identities*** between Newton's Universal Gravitational Law and Coulomb's Law, this paper provides argumentations which indicate that the Electric Field should be also recognized as a form of Acceleration.

This paper also proposes a relatively simple experiment, which if implemented, it might prove, (or disprove), the above presented statement that the Electric Field should be also recognized as a form of Acceleration.

If this experiment will be implemented, and its results will be successful, such that the Electric Field will be also recognized as a form of Acceleration, this will also result in significant implications.

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Introduction

The issue of Mass Bodies attraction was initially investigated by Newton.

Newton's measurements concluded that two Mass Bodies attract each other according to Newton's Universal Gravitational Law, which is formulated as [1] :

$F = G\cdot(m_1\cdot m_2)/ r^2$

Where G is the Gravitational Constant and is equal to 6.674×10^{-11} $m^3\cdot kg^{-1}\cdot s^{-2}$, m_1 is the Mass magnitude of the first

Mass body, m_2 is the Mass magnitude of the second Mass body and r is the distance between the center of Mass of the two Mass Bodies.

The Universal Gravitational Law, presented above, provides the amount of the Force that attracts these two Mass Bodies.

However, Newton could not provide a complete explanation relating to what causes this force, or what is exactly the ***origin*** of the attraction between Mass Bodies.

Newton tried to explain the ***origin*** of the attraction force between Mass Bodies by introducing the concept of the Gravitational Field.

Newton stated that a Mass Body creates a Gravitational Field around it, which generates the Force presented in the Universal Gravitational Law.

However, Newton could not explain how any Field, including his Gravitational Field, can cause the attraction forces between bodies.

Newton's Gravitational Field is presented by the following equation [2] :

$g = G \cdot m / r^2$

Where g is the Gravitational Field magnitude, G is the Gravitational Constant, which was already presented above in the Universal Gravitational Law, m is the Mass magnitude of the Mass Body which creates this Gravitational Field g and r is the distance between the center of Mass of this Mass Body, and the point in Space, where this Gravitational Field g is measured.

Thus, the Universal Gravitational Law can be reformulated as:

$F = m \cdot g$

Where m is the magnitude of the Mass Body on which the Gravitational Field g exerts the force F.

However, as already stated above, the notion of a Field, does not provide a complete answer to the question: how can a Field generate the Forces that it is assumed to create?

Thus, the question:

What is the **origin** of the Force presented by the Universal Gravitational Law?

Remained an unanswered question, until the introduction of Einstein's General Relativity Theory [3] .

Einstein succeeded to explain the ***origin*** of the attraction forces between Mass Bodies by concluding that Newton's Gravitational Field is a form of Acceleration. This conclusion led to the introduction of Einstein's Interwoven Space/Time concept, which succeeded to explain the ***origin*** of the attraction forces between Mass Bodies.

That conclusion can be derived directly from Newton's work.

Newton's Second Law of Motion[4] states, that a force F exerted on a Mass Body of Mass magnitude m obeys the following equation:

$F = m \cdot a$

Where a is the Acceleration that this Mass Body of Mass magnitude m acquires because of the force F exerted on it.

However, the above already presented, that a Gravitational Field g exerted on a Mass Body of Mass magnitude m also results in a force F exerted on this Mass Body:

$F = m \cdot g$

Thus, from the above follows that: $g = a$

Thus, the Gravitational Field must also be a form of Acceleration.

Argumentations which imply that the Electric Field should be also recognized as a form of Acceleration

As already presented above, Einstein concluded that Newton's Gravitational Field is a form of Acceleration, and it was also showed that this conclusion can be also derived directly from a version of Newton's Universal Gravitational Law, F=mg, and Newton's Second Law of Motion, F=ma.

But this conclusion might be also obvious from analyzing ***only*** Newton's Universal Gravitational Law, $F = G \cdot (m_1 \cdot m_2) / r^2$, without using Newton's Second Law of Motion, F=ma.

During the attraction process between the Mass Bodies the Force F in $F = G \cdot (m_1 \cdot m_2) / r^2$ is dependent only on the distance r between these Mass Bodies, since G is a constant and the Mass magnitudes of the Mass Bodies also do not change, assuming that the velocities in the attraction process are negligible in comparison to the velocity of Light, implying that the Mass increase with velocity, implied from Einstein's Special Relativity Theory, is also negligible.

Thus, during the attraction process, the force F continuously increases, as the distance r between the bodies continuously decreases.

Since this Force F is what causes the attraction between the Mass Bodies, the fact that during this attraction process the Force F continuously increases, this should imply, that during the attraction process, the velocities of the attracting Mass Bodies also continuously increase, which implies that during the attraction process, the Mass Bodies are also Accelerating towards each other.

Since the Gravitational Field is what causes the Force F, and thus, is actually the cause of the attraction between the Mass Bodies which, as concluded above, are Accelerating towards each other, it should be concluded that the

Gravitational Field is a form of Acceleration.

And this conclusion is the result from an analysis done ***only*** on Newton's Universal Gravitational Law, $F = G\cdot(m_1\cdot m_2)/ r^2$, without using Newton's Second Law of Motion, F=ma, as presented above.

However, the analysis done only on Newton's Universal Gravitational Law, $F = G\cdot(m_1\cdot m_2)/ r^2$, without using Newton's Second Law of Motion, F=ma, reveals more than what was presented above.

Since the Gravitational Field itself, presented by the equation: $g = G\cdot m/ r^2$, also continuously increases during the attraction process, as the distance r between the bodies continuously decreases, then, the Gravitational Field, which is the cause of the attraction between the Mass Bodies, is not only a form of Acceleration, it is a form of Acceleration which increases continuously, during the attraction process between the Mass Bodies.

The nowadays Science of Physics, does not recognize (yet) the Electric Fields as being also a form of Acceleration, as the Gravitational Field is already recognized as a form of Acceleration.

But, similar to what was presented, that Newton's Gravitational Field is a form of Acceleration, which can be derived ***only*** from analyzing Newton's Universal Gravitational Law,

$F = G\cdot(m_1\cdot m_2)/ r^2$, without using Newton's Second Law of Motion, F=ma, similar argumentations might apply also to the claim, that Electric Fields might also be concluded to be forms of Acceleration, only by analyzing the Coulomb's Law.

Analogous to Newton’s Universal Gravitational Law, which provides the Force of attraction between Mass Bodies, Coulomb’s Law provides the Force of the attraction or the repulsion between Electric Charges.

Coulomb’s Law is presented by the following formula[5]:

$F = Ke\cdot(q_1\cdot q_2)/r^2$

Where Ke represents the Coulomb’s Constant and is equal to $8.99\times10^9\ N\cdot m^2\cdot C^{-2}$, q_1 is the amount of Electric Charge in the first Electric Charge, q_2 is the amount of Electric Charge in the second Electric Charge and r is the distance between the center of Mass of the bodies that carry these two Electric Charges.

It should be noticed that the ***structure*** of the Newton’s Universal Gravitational Law and the ***structure*** of the Coulomb’s Law are ***identical***.

Thus, as already stated above, similarly to the argumentations presented above, that Gravity can be recognized as a form of Acceleration ***only*** by analyzing Newton's Universal Gravitational Law, without using also Newton's Second Law of Motion, similar argumentations apply which imply the Electric Field should be also recognized as a form of Acceleration, only from analyzing Coulomb's Law.

These argumentations are:

During the attraction or the repulsion process between the Electrically Charges Bodies the Force F in $F = Ke\cdot(q_1q_2)/r^2$ is

dependent only on the distance r between these Electrically Charged Bodies, since Ke is a constant and the Electric Charges magnitudes embedded in the Electrically Charged Bodies also do not change.

Thus, during the attraction or the repulsion process, the force F continuously increases or decreases, as the distance r between the Electric Charges continuously decreases or increases (depending if the Electric Charges attract or repel each other).

Since this Force F, presented by Coulomb's Law, is what causes the attraction or the repulsion between the Electrically Charged Bodies, the fact that during this attraction or repulsion process the Force F continuously increases or decreases, (depending if the Electric Charges attract or repel each other), this should imply, that during the attraction or the repulsion process, the velocities of the attracting or repelling Electrically Charged Bodies also continuously increase or decrease, which implies that during the attraction or the repulsion process, the Electrically Charged Bodies are also Accelerating towards each other, or Decelerating from each other.

Since the Electric Fields involved in the above-described process are the cause of the force F and thus, also the cause of the attraction or the repulsion between the Electrically Charged Bodies which, as concluded above, are accelerating towards each other, or decelerating from each other, it should be concluded that these Electric Fields are also forms of Accelerations or Decelerations (depending if the Electrically Charged Bodies attract or repel each other).

And this conclusion is the result from an analysis done ***only*** on Coulomb's Law,

$F = Ke \cdot (q_1 \cdot q_2)/r^2$, as presented above.

However, the analyzing done only on Coulomb's Law, $F = Ke \cdot (q_1 \cdot q_2)/r^2$, reveals more than what was presented above.

Since the Electric Fields involved, presented by the equation: $e = Ke \cdot q/r^2$, also continuously increase or decrease during the attraction or the repulsion process, as the distance r between the Electrically Charged Bodies continuously decreases or increases, then, the Electric Fields, which are the cause of the attraction or the repulsion between the Electrically Charged Bodies, are not only forms of acceleration or deceleration, these Electric Fields are forms of acceleration or deceleration which increases continuously, during the attraction or the repulsion process between the Electrically Charged Bodies.

But since Coulomb's Law ***does not*** contain any Mass component in its equation, it is reasonable to conclude that the above-described Acceleration or Deceleration property, derived from analyzing ***only*** the Coulomb's Law, is caused ***only*** by the Electric Fields created by Electric Charges embedded in the Electrically Charged Bodies presented in the Coulomb's Laws, which implies that Electric Fields are also forms of Acceleration.

A simpler presentation that the Electric Field should be also recognized as a form of Acceleration

In the previous chapter of this paper, detailed argumentations were provider, which result in the conclusion that the Electric Field should be also recognized as a form of Acceleration.

This presentation was provided in order to point out all the details which are required to arrive at the conclusion that the Electric Field should be also recognized as a form of Acceleration.

But the ***obvious structural identities*** between Newton's Universal Gravitational Law,

$F = G\cdot(m_1\cdot m_2)/ r^2$ and Coulomb's Law, $F = Ke\cdot(q_1\cdot q_2)/r^2$ can be used to provide a somewhat simpler presentation of the claim that the Electric Field should be also recognized as a form of Acceleration.

Because the Gravitational Field, is already recognized, by the nowadays Science of Physics as a form of Acceleration, and because this Gravitation Field, presented in Newton's Universal Gravitational Law, is the cause of the attraction between the Mass bodies, then, the following can be concluded:

Because the ***structure*** of the Coulomb's Law is ***identical*** to the ***structure*** of Newton's Universal Gravitational Law, and the Electric Field is the cause of the attraction or the repulsion of the Electrically Charged bodies presented in the Coulomb's Law, then, it should be concluded, that like the Gravitational Field in Newton's Universal Gravitational Law, which is already recognized by the nowadays Science of Physics as a form of Acceleration, also the Electric Field, in Coulomb's Law, should be also concluded to be a form of Acceleration.

A proposed experiment for validating (or disproving) the statement that the Electric Field should be also recognized as a form of Acceleration

This paper also suggests a physical experiment that might prove (or disprove) the prediction that the Electric Field should be also recognized as a form of Acceleration.

Electrically Charged Bodies always embed Electric Charge ***and*** Mass. However, the Coulomb's Force is much more ***potent*** than the Gravitational Force.

This can be demonstrated by the following:

The Gravitational Force between two 1-kg Mass Objects that are 1 meter apart is

$6.67\cdot10^{-11}$ [6] Newtons, while the Attraction or the Repulsion Force caused by the Coulomb's Law, between two 1 Coulomb Electrically Charged Bodies, held 1 meter apart, is

$9\cdot10^{9}$ [7] Newtons.

The above clearly indicates that the Coulomb's Force might be more ***potent***, as compared to the Gravitational Force, by a magnitude factor of $1.35\cdot10^{20}$!

Thus, if Electric Fields are also forms of Accelerations, the Acceleration between Electrically Charged Bodies, attracted to, or repelled from each other, because of Coulomb's Law, should be dependent mainly on the amount of the Electric Charge that these bodies carry and not on the Mass magnitudes of these bodies, as Newton's Second Law of Motion states.

Thus, this paper proposes a relatively simple experiment which might check if the Acceleration between Electrically Charged Bodies, attracted to, or repelled from each other, because of Coulomb's Law, is dependent mainly on the amount of the Electric Charge that these bodies carry and not on the magnitudes of the Mass that these bodies embed, as Newton's Second Law of Motion (F=ma) states.

That experiment suggests letting two Electrically Charged Bodies, at a specific distant L apart, being attracted to each other under Coulomb's Law.

In the first phase of the experiment the bodies should be of equal Mass magnitudes, embedding equal amounts of Electric Charges, each of a different polarity, to enable the attraction between the bodies under the Coulomb's Force. The experiment should measure the time it takes for these bodies to collide.

Then, the experiment is repeated with two additional Electrically Charged Bodies with the same amount of Electric Charge but with a much bigger Mass magnitude (for example, twice the Mass magnitude that the Electrically Charged Bodies had in the first phase of the experiment).

Newton's Second Law of Motion predicts that the time to collision, in that second phase of the experiment, would be different (bigger), because the Forces exerted on the bodies will be the same, as in the first phase of the experiment, because the Electric Charges are the same in both phases of the experiment, (and thus, the Coulomb's Force will be the same, and the Gravitational Force is negligible in comparison with Coulomb's Force), but the Mass magnitudes of the bodies are bigger in the second phase of the experiment, which will result in a smaller Acceleration.

This paper, on the other hand, predicts that the time to collision in both phases of the experiment would be virtually the same, because the Acceleration between Electrically Charged Bodies, attracted to, or repelled from each other under the Coulomb's Law, is dependent mainly on the amount of the Electric Charge that these bodies carry and not on the Mass magnitudes of these bodies, as Newton's Second Law of Motion (F=ma) states.

If the experiment will prove that the time to collision will be virtually the same, in both phases of the experiment, this will provide validity to what is presented in this paper.

An immediate implication if the Electric Field will be recognized as a form of Acceleration

Thus, as presented in the previous chapter of this paper, if Electric Fields are also forms of Accelerations, the Acceleration between Electrically Charged Bodies, attracted to, or repelled from each other, because of Coulomb's Law, should be dependent mainly on the amount of the Electric Charge that these bodies carry and not on the Mass

magnitudes of these bodies, as Newton's Second Law of Motion states.

The above also implies that Newton's Second Law of Motion, F=ma, should undergo a suitable modification, in scenarios relating to Electrically Charged Bodies, attracting or repelling each other, under Coulomb's Law, which implies that in such scenarios Newton's F=ma Law should be replaced with a different Law, namely, F=kqa, as is presented below:

An Electric Field e, generated by an Electric Charge q, is defined by:

$e = Ke \cdot q/r^2$

Where e is the Electric Field magnitude, Ke is the Coulomb's Constant, already presented in a previous chapter of this paper, q is the magnitude of the Electric Charge generating this Electric Field e and r is the distance between the center of Mass, of the body which embeds this Electric Charge, and the point in Space where this Electric Field e is measured.

Thus, Coulomb's Law can be reformulated as:

$F = q \cdot e$

Where F is the Coulomb's Force exerted on an Electric Charge q by an Electric Field e.

The above is similar to:

$F = m \cdot g$,

Where m (Mass) is replaced by q (Electric Charge),

g (the Gravitational Field) is replaced by e (the Electric Field),

and F (the attraction Gravitational Force) is replaced by F (the attraction or repulsion Force under Coulomb's Law).

Thus, as g, the Gravitational Field, is already recognized as a form of Acceleration, if e, the Electric Field, is also found to be a form of Acceleration, as predicted in this paper, then,

$F = q \cdot e$ can be also presented as:

$F = q \cdot ka$

Where a is the Acceleration exerted on an Electric Charge q under Coulomb's Law, which also implies, as stated above, that for Electrically Charged Bodies, attracted or repelled under Coulomb's Law, F = ma should be replaced by F = kqa.

It should be also emphasized, that although the Gravitational Field g is equated exactly with the Acceleration a, in case of the Electric Field, it is not possible, at this stage, to completely equate the Electric Field e with the Acceleration a, and all that can be established, at this stage, is that the Electric Field e is equal to the Acceleration multiplied by a certain factor k, or, as stated above: e=ka. This is because of the following:

The conclusion that the Gravitational Field g is also a form of Acceleration, derived from an analysis performed***only*** on

Newton's Universal Gravitation Law without using Newton's Second Law of Motion (F=ma), does imply that the Gravitational Field g is a form of Acceleration, but does not establish yet that the Gravitational Field g is equal exactly to the Acceleration a.

Only by using also Newton's Second Law of Motion (F=ma), the equation g=a can be established.

Similarly, in case of the Electric Field, the conclusion that the Electric Field e is a form of Acceleration, derived from analysis performed on the Coulomb's Law, is not sufficient to establish that e=a, and all it can be established, at this stage, is that e is equal to the Acceleration a multiplied by a certain factor k, which must be established, by further experimentation, or as stated already above, e=ka.

Summary and Conclusions

This paper presents the prediction that Electric Fields are also forms of Acceleration, as the Newton's Gravitational Field is already recognized as a form of Acceleration.

The prediction that Electric Fields are also forms of Acceleration, is supported by argumentations relying on the ***structural identities*** between Newton's Universal Gravitational Law and Coulomb's Law.

However, the prediction that Electric Fields are also forms of Acceleration also implies that the Acceleration between Electrically Charged Bodies, attracted to, or repelled from each other, because of Coulomb's Law, is dependent mainly on the amount of the Electric Charge that these bodies carry and not on the magnitudes of the Mass embedded in these bodies, as Newton's Second Law of Motion (F=ma) states.

This paper also proposes a physical experiment to validate (or disprove) the prediction that the Acceleration between Electrically Charged Bodies, attracted to, or repelled from each other, because of Coulomb's Law, is dependent mainly on the amount of the Electric Charge that these bodies carry and not on the magnitudes of the Mass embedded in these bodies.

This experiment is relatively simple to implement, but still requires means and funds which are beyond the reach of the author of this paper, thus, the author of this paper hopes, that this paper will bring about the execution of this experiment, and, hopefully, the validation of what is presented in this paper.

If this experiment will be implemented, and its results will be successful, such that the Electric Field will be also recognized as a form of Acceleration, this will also result in significant implications.

One immediate implication would be the realization, that for Electrically Charged bodies, attracted or repelled under Coulomb's Law, F=ma should be replaced by F=kqa, as described in the body of this paper.

Also, additional, more significant implications, will result if the Electric Field will be recognized as a form of Acceleration. Such implications are presented in additional papers by the author of this paper.

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